

figured, one hundred and fifty in number, seem to have been well selected, and the plates in which they are represented by Mr. Keulemans are in the style which has won him so much reputation as an ornithological artist. But all these merits pale before the admiration which the bold conception and patient execution of this grand undertaking excites. There is no English work on natural history comparable in these respects with the "Biologia Centrali-Americana," and the only foreign one which it calls to remembrance is the marvellous "Madagascar" of the late M. Grandidier. The debt due by naturalists of all branches and of all countries to the enterprise, the zeal, and the perseverance of both Messrs. Salvin and Godman, and to the munificence of the latter, for without that all the rest would have availed little or nothing, is one that can never be repaid. A. N.

VECTOR MECHANICS.

Die Grundlagen der Bewegungslehre von einem modernen Standpunkte aus. By Dr. G. Jaumann. Pp. vi + 422. (Leipzig: J. A. Barth, 1905.)

THIS work is intended as a systematic general introduction to mechanics; as in the recent English exposition of Webster, the whole field of solid and deformable bodies is considered, so that the book has a wide range—a feature which must necessarily be purchased to some extent at the expense of depth.

Dr. Jaumann, following a method which now enjoys some popularity on the Continent, treats the subject by vectorial methods throughout. The first chapter introduces the ideas of velocity and acceleration, and with them the ideas of the vector and the scalar and vector products of two vectors. This is very natural and well written; it is, however, followed by the introduction of dyads, which was scarcely to be expected at this early stage of the work; and when the author, as is the habit of those writers who apply vectors, takes the liberty of making some additions to the vector calculus itself, and plunges us forthwith into an able but somewhat difficult discussion of "rotary" dyads, we are thrown into doubt as to the class of readers for whom the book is designed.

After this we come back to the ideas of partial and absolute acceleration, illustrated by astronomical considerations, and to the conception of gravitation, with an account of Kepler's laws. This closes the first section of the book, which, though interesting, leaves an unsatisfied and helpless feeling behind it, for the student (if the book is written for students) has not learnt how to find for himself the path of a point in a given field of acceleration, which is surely the main problem of this part of the subject. Thus, although Foucault's pendulum is described, the theory of it—which would make no greater demand on the mathematical capacity of the reader than the rotary dyads require—is not worked out.

The author now introduces the idea of mass, which is defined (as in most good modern works) by means of what used to be called the principle of action and

reaction; in other words, the ratio of the masses of two particles is defined as the ratio of the accelerations which they induce in each other when moving under each other's influence, and the idea of "force" is altogether abandoned. These ideas are again supplemented by astronomical illustrations, even the tides being worked into the scheme; and after this we have more vector calculus, with Stokes's theorem in the vector notation.

Dr. Jaumann next discusses rigid bodies, rigidity itself being defined by a vector equation! He discusses the constants of inertia, and solves some very elementary problems, and then passes on to a sketch of acoustics.

The last principal division of the book deals with deformable media—elastic solids, liquids, and gases. The treatment here is good so far as it goes, but too slight to be very satisfying.

Considering the work as a text-book, it must be said that the difficulty of the vectorial methods so freely used is hopelessly out of proportion to the results achieved. The student who has mastered the whole machinery of the treatise will still be unable to solve for himself any but the most rudimentary of the actual problems of dynamics. The author seems to overlook the cardinal fact that the solution of every moving material system depends ultimately on the integration of the associated differential equation, or some equivalent process, and that this is the really difficult part of the subject, the rest being child's play in comparison. A book which devotes scores of pages to symbols and formulæ, and yet never brings the reader into close grip with this essential kernel of the subject, is open to the charge of beating about the bush.

GREATER AUSTRIA.

Geologie der Umgebung von Sarajevo. By Ernst Kittl. Part iv. of the *Jahrbuch der k.k. geologischen Reichsanstalt* for 1903. (Vienna: R. Lechner, 1904.)

THIS general essay, with its plates of fossils and numerous geological sections in the text, corresponds to one of the memoirs on special districts issued by our own Geological Survey. It includes, moreover, a folded geological map on the scale of 1:75,000, and is thus a complete guide for future scientific visitors. The map itself reminds us of the charm of the Bosnian capital, set in its semicircle of craggy hills, where the gorge of the Miljacka broadens out towards the alluvial basin of Ilidže. We trace the mountain-road from the Ivan Pass coming out suddenly on this cultivated plain, and see again the minarets of Sarajevo shining like white masts under the background of Triassic precipices.

The author's introduction shows how the geological survey by Austrian observers followed hard upon the capture of the city, which had risen fanatically to arms. The famous ammonite-locality of Han Bulog, on the way to Mokro, was thus discovered as early as 1880; and the important part played by Triassic rocks east of Sarajevo was made known by

Bittner and Kellner, and in 1892 by the author, who was sent by von Hauer to collect for the museum in Vienna. The whole Alpine Trias seems well represented near the city, some of the massive limestones, rich in *Diplopore*, being spoken of as "Riffkalk." The red limestone with *Ptychites*, the rock best known in our collections, is on an Upper Muschelkalk horizon. While the Eocene period is probably represented by a Flysch-facies, the Oligocene and Miocene lagoons and freshwater lakes show that the mountain-land of Bosnia was rising above the sea in Middle Cainozoic times.

The author's detailed descriptions of the region, district by district, are illustrated by sections drawn on a correct vertical and horizontal scale, and by occasional sketches and photographic views. As a type of the sketches, we may mention the effective Fig. 16 (p. 611), showing the rounded forms of the Flysch deposits banked and sometimes faulted against the scarped Triassic masses to the east. Another section (p. 639) shows well how the Flysch strata, extending north towards Doboj and the great Hungarian plain, have been tilted and overfolded during the orogenic movements of the Dinaric Alps, which continued, as we now know, far into Pliocene times. The steep forms of the lowland landscape, cut into by frequent streams, are readily appreciated from the section.

The palæontological portion of the memoir records fossils from the "Kulmschiefer," including, curiously enough, *Modiola lata*, described by Wheelton Hind as recently as 1896. The author supports (p. 671) E. Haug and J. P. Smith in restoring *Goniatites* as a restricted generic term, so that we again have *Goniatites crenistria* and *truncatus*, as well as *sphaericus* and *striatus*. *Osmanoceras* and *Tetragonites* are described as new genera of goniatites. The Bellerophon-beds of the Upper Permian yield, amid a fairly rich fauna, *Promyalina*, a new member of the Aviculidæ. These forms, and a number of new species, are suitably figured, either in the text or in the plates. It is pleasant to recall the book-shops in Sarajevo on the way to the bazaar and the river-side, where this last product of Austrian investigation will appear for sale under the shadow of the Sultan's mosque.

G. A. J. C.

ECONOMIC SCIENCE.

Economic Essays by Charles Franklin Dunbar.

Edited by O. M. W. Sprague, with an introduction by F. W. Taussig. Pp. xvii+372. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1904.) Price 10s. 6d. net.

NO American economist has been held in higher repute for judiciousness, breadth of view, and "soundness" than Charles Franklin Dunbar, professor of political economy at Harvard from 1871 until his death in 1900, sometime Dean of the college (between 1876 and 1882), and later Dean of the faculty of arts and sciences. But his output was never extensive, perhaps because the university teach-

ing of political economy was not his first choice, or at any rate not his first calling. It was not until Prof. Dunbar had attained the ripe age of forty-one that he was appointed to his professorship at Harvard. Previously he had engaged in newspaper work, and had edited between 1859 and 1869 the *Boston Daily Advertiser*. To the work of the editorship of this paper Prof. Dunbar returned for a brief space to fill a breach at a time of crisis in 1884.

Having taken to the profession of teaching after engaging in practical affairs and feeling the excitements of politics, it is somewhat remarkable that Prof. Dunbar's interests after his appointment at Harvard should have been "academic" to so exclusive an extent. He studiously avoided making contributions to magazines upon the economic aspects of current events, and appears to have held that it was the main duty of the economist to trace the leading trends of social forces rather than to spend his energies in directing minor circumstances. Prof. Dunbar's best known work was done upon the subject of banking, and we are told by Prof. Taussig in his introduction to this collection of his late colleague's economic essays that he had meditated a comprehensive treatise relating to America upon the wider subject of which banking is a part, namely, financial history. Prof. Dunbar's little "History of Banking" is read to-day by all students of economics of this country and the United States at least.

The collection of essays before us contains a good deal of material that was not easily accessible previously, and some matter that is now published for the first time, upon the range of subjects which Dunbar made peculiarly his own. Eight out of the twenty essays included deal specifically with banking, and some of them are valuable contributions to our knowledge of the history of banking—for instance, the two dealing with early banking schemes in England and the Bank of Venice. Eight more essays are concerned more particularly with finance, for example, analyses of certain crises, the examination of the direct tax of 1861, and the discussion of the precedents followed by Alexander Hamilton. The remaining four essays arose out of the author's other chief interest, namely, the literature of classical economics; they are entitled "Economic Science in America, 1776-1876," "The Reaction in Political Economy" (written in 1886), "The Academic Study of Political Economy," and "Ricardo's Use of Facts." Certain of these essays were executed so long ago as almost to have become themselves a part of the old literature of classical economics; but, taken as a whole, they will prove enlightening even to economists who have benefited from the analysis effected and researches carried out since Prof. Dunbar's discussions appeared, for without exception the essays collected in this volume are thorough, scholarly, well pondered, and finely proportioned. Prof. Sprague's work of editorship appears to have been done admirably. All students of economics will be grateful to him for having made a collection of Prof. Dunbar's scattered writings and brought to the press the work which he left behind in manuscript.